

# E. Feng (ANL): Higgs CP Fraction

- Matrix element method to measure spin, CP, and couplings in  $H \rightarrow ZZ \rightarrow 4l$ 
  - Unbinned maximum likelihood fit to analytical prediction using 3 masses ( $m_{4l}, m_{12}, m_{34}$ ) and 5 angles ( $\cos(\theta^*), \phi_1, \cos(\theta_1), \cos(\theta_2), \Delta\phi$ ) from 4 leptons
- Characterize sensitivity to CP-odd fraction projected onto  $H \rightarrow ZZ$  final state by fitting to linear combination of  $0^+$  and  $0^-$  hypotheses as function of 14 TeV lumi
- CP-odd component corresponds to non-zero  $g_4^{(0)}$  form factor in ME:

$$A(X \rightarrow V_1 V_2) = v^{-1} \left( g_1^{(0)} m_V^2 \epsilon_1^* \epsilon_2^* + g_2^{(0)} f_{\mu\nu}^{*(1)} f^{*(2),\mu\nu} + g_3^{(0)} f^{*(1),\mu\nu} f_{\mu\alpha}^{*(2)} \frac{q_\nu q^\alpha}{\Lambda^2} + g_4^{(0)} f_{\mu\nu}^{*(1)} \tilde{f}^{*(2),\mu\nu} \right),$$

- Statistical uncertainty of ~8% (3%) can be achieved with 300 (3000)  $\text{fb}^{-1}$  at 14 TeV
  - Includes detector acceptance
  - Generating fastsim for systematics, which should be relatively small
- Additional studies may include non-minimal couplings for spin-2, but lower sensitivity

